

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Human activities & cultural practices	Sounds / Viewscapes / Lightscapes	Monitor sound sources, frequencies, occurrence, and levels	H1	Alien, Natural, Human Soundscapes	Are alien species sounds appropriate to management zone? Are naturally present sounds maintained at appropriate frequencies, occurrence, db levels?	point/plot sampling	frequency (hz), frequency (time), Sound durations, Sound levels, sound source identification	2.6	
		Monitor landscape / seascape appearance	H2	Viewsheds	Are landscapes/seascapes changing?	historical photos	qualitative	2.7	
		Monitor light levels and characteristics of light/dark cycles	H3	Lightscape & Night sky	Are natural light/dark cycles maintained as appropriate (eg no inappropriate shading, etc)? Is artificial light restricted to basic human safety needs only?	above ground (aerial or satellite) vs on ground measurements (photographs)	Light intensity, spatial distribution, temporal frequency	2.7	
	Land Use	Monitor water use adjacent to or upstream from park boundaries	H5	Water Use(s) Within & Surrounding Parks	Which resources are most at risk due to conflicting water uses (withdrawals, diversions, inputs)?	Stream gages, well monitoring/logs	Volume, rate	3.0	
		Monitor land use adjacent to, or upstream of, park boundaries	H6	Land Use(s) Within & Surrounding Parks	What areas are most at risk due to conflicting adjacent changes in land use (e.g. ranching, urbanization)?	Aerial photography, mapping, plots	change detection maps	3.4	
	Park Use & Activities	Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas	H7	Litter/debris	What are levels of litter within parks? Where is littering/ dumping of trash taking place? What are areas of marine debris deposition?	surveys of activity & locations	quantity present / removed	3.1	
		Monitor patterns of park visitation, use & damage (terrestrial & marine)	H8	Marine Recreational Activities & Groundings/Anchor Damage	Are use levels changing? What are trends?	plots, transects, and surveys	density of fish line, density of lead sinkers on bottom, level/degree of trampling, percent broken coral, quantity of beach users, quantity of diver hours, water films	2.5	
			H9	Footprint & Visitor Use Patterns	Are locations and/or intensity in use areas (visitor or management) changing? Are use levels associated w/detectable levels of resource change?	VERP program, repeated mapping of use areas, plot sampling	erosion, plant cover	3.3	
			H10	Subsistence Farming/Agriculture	What areas are affected by subsistence farming and how are these practices modifying plant communities?	Mapping/gps perimeter of farmed areas, aerial photos	area covered by disturbance, Distribution	1.2	
		Monitor incidence & occurrence of bioprospecting	H11	Bio-prospecting Harvest	Are harvest levels changing? What are trends? Is human harvest changing distribution, abundance, or other population characteristics? What are current trends (research activities) in bioprospecting.	Surveys in various targeted habitats: pharmaceutical plants, thermal pools, coral reefs, intertidal zones, etc. Quantification of research activity, harvest levels, and of targeted population characteristics.	harvest composition, harvest quantity, Research activity	1.9	
		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand)	H12	Coral/Sand Mining Harvest	Are harvest levels changing? What are trends?	plots/transects and remote sensing	harvest composition, harvest quantity	1.2	
			H13	Culturally Significant Plant Harvest	What impact does gathering of plant materials by humans have on harvested populations?	Transects, plots	Cover, demographics, density	2.5	
			H14	Culturally Significant Vertebrate Species Harvest	Is human harvest changing distribution, abundance or other population characteristics? Can there be a balance between management goals of sustaining population numbers and culturally important species?	Systematic monitoring and/or population surveys of harvested species	collection statistics, counts by class, Creel counts	1.6	
	Management Zones	Monitor patterns and effects of use and management	H16	Management Zone uses	Are locations, extent and/or intensity in use areas (visitor or management) changing? Are use levels associated w/detectable levels of resource change?	mapping	quantify and qualify uses and extent(s)	3.1	
		Monitor effects of management practices on wilderness character	H17	Wilderness Areas - HAVO, HALE, other Unofficial	Monitor to identify the need for, or effects of, management actions	Limits of acceptable change. Nature, magnitude, and source of impacts	Limits of Acceptable Change (LAC)	1.1	
Physical / Chemical Conditions	Soil, Water, & Nutrient Dynamics	Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous	P11	Biogeochemical Cycles - Nutrient Cycling	How are fluctuations changing over time (source, directions, levels of flow)?	monitoring plots	Aquatic senescence, Coral growth-CaCO3 deposition, Forest productivity (litter rain, incremental growth), Key constituents (N, K, CaCO3)	2.5	
		Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent	P42	Cave Environmental conditions	Are cave systems impacted and changing as a result of above ground changes or human activity & cultural practices? Are environmental conditions in caves changing (temp, humidity, light, etc.)?	Station/plot data	litterfall, Species distribution & abundance, human use levels, temperature, humidity, ground compaction, etc.	2.0	
	Geology	Monitor patterns of distribution & extent of community types	T1	Soil and Pollen Landscape History	Are intact paleo landscapes being altered?	Mapping; Pollen and charcoal assemblages, soil horizons, etc.	Rate of change?	2.3	
			T2	Ecozone Boundaries	Are locations of ecotones changing? Are the communities that comprise ecological boundary zones changing?	vegetation mapping, landscape photography, high spatial resolution plots	change detection maps	2.1	
			T3	Landscape Fragments, Patch Size, Land Cover	How are the distributions of plant communities and land cover inside and immediately outside the Parks changing over time?	Mapping, repeat photography	FRAGSTAT statistics, Vegetation type	2.6	
	Terrestrial Ecosystems	Monitor fire regimes and effect on vegetation	T4	Fire Effects & Dynamics: Vegetation and Landscape Level	What is a natural fire frequency? What changes in plant community composition and structure result from fire? What are the biogeochemical effects of fire?	Transects, plots, histories	change in vegetation structure, Cover, density, erosion, nutrient loss, species composition	2.5	

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Producers	Monitor community composition, structure, and productivity
	Freshwater Ecosystems	Consumers	Community Monitor community dynamics, structure, function, and composition Monitor disease incidence and impacts, especially on native species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Benthic	Landscape Community Monitor patterns of distribution & extent of community types Monitor community dynamics, structure, function, and composition Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Water column (motile)	Community Monitor community dynamics, structure, function, and composition Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species Monitor occurrence of non-established (incipient) invasive species
		Intertidal	Community Monitor community dynamics, structure, function, and composition Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species